

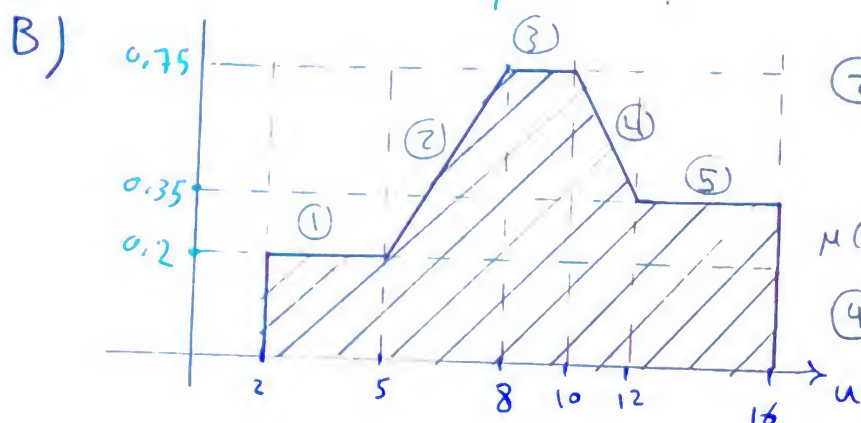
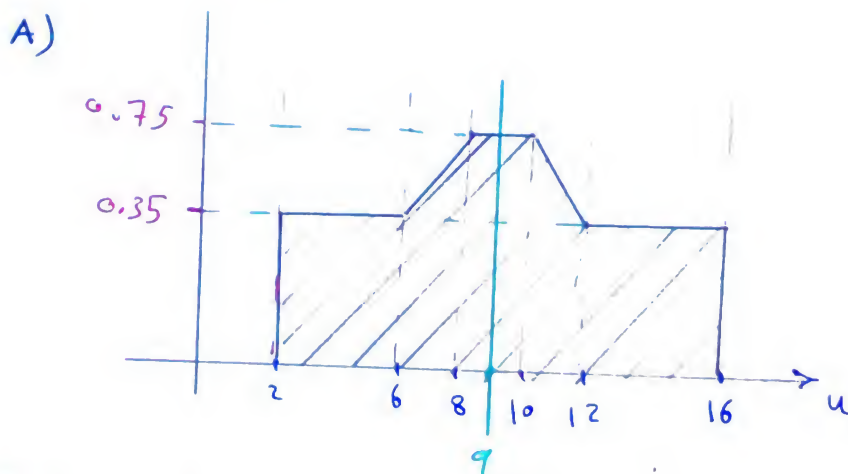
2/11/2016

السبيل

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[4] م. د. د.

II Find the crisp output of the fuzzy ~~set~~ controller that has the following overall fuzzy output as shown in the following cases:-



(2)  $\frac{\mu(u) - \mu_1(u)}{\mu_2(u) - \mu_1(u)}$

$\mu(u) = \frac{0.55}{3}u - \frac{2.15}{3}$

(4)  $\mu(u) = 0.2u + 2.75$

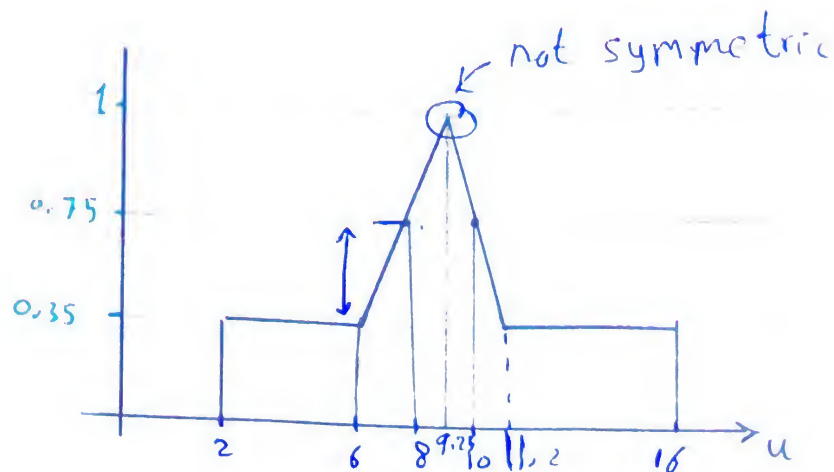
A)  $u^{crisp} = \frac{\sum \mu(u_i) u_i}{\sum \mu(u_i)} = \frac{0.75 \times 9}{0.75} = 9$

B)  $u^{crisp} = \frac{\int \mu(u) u du}{\int \mu(u) du} = \frac{I_1}{I_2}$

$I_1 = \int_2^5 0.2u du + \int_5^8 \left(\frac{0.55}{3}u - \frac{2.15}{3}\right) u du + \int_8^{10} 0.75 u du + \int_{10}^{12} (-0.2u + 0.75) u du + \int_{12}^{16} 0.35 u du$

$I_2 = \int_2^5 0.2 du + \int_5^8 \left(\frac{0.55}{3}u - \frac{2.15}{3}\right) du + \int_8^{10} 0.75 du + \int_{10}^{12} (-0.2u + 0.75) du + \int_{12}^{16} 0.35 du$

$u^{crisp} = \frac{I_1}{I_2} = 12.3$



$$\mu(u) = 0.2u - 1.2 + 0.35$$

$$\mu(u) = 0.2u - 0.85$$

$$1 = 0.2u - 0.85$$

$$u = \frac{1.85}{0.2} = 9.25$$

Not Symmetrical

$$\# \frac{\mu(u) - 1}{u - 9.25} \neq \frac{-0.25}{0.75} = \frac{-1}{3}$$

$$3\mu(u) - 3 = -u + 9.25 \Rightarrow \mu(u) = \frac{-u}{3} + \frac{12.25}{3}$$

$$\# 0.35 = \frac{-u}{3} + \frac{12.25}{3}$$

$$0.35 \times 3 - 12.25 = \frac{3}{2} - u \Rightarrow u = 11.2$$

$$u_{crisp} = \frac{\int \mu(u) u du}{\int \mu(u) du} = \frac{I_1}{I_2}$$

$$I_1 = \int_2^6 0.35u du + \int_6^{9.25} (0.2u - 0.85)u du + \int_{9.25}^{11.2} \left(\frac{-u}{3} + \frac{12.25}{3}\right)u du + \int_{11.2}^{16} 0.35u du$$

= ✓

$$I_2 = \checkmark \Rightarrow u_{crisp} = \frac{I_1}{I_2} = \checkmark$$

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$$e, \Delta e \rightarrow \{NM, NS, Z, PS, PM\}$$

$$u \rightarrow \{NL, NM, NS, Z, PS, PM, PL\}$$

$$e \rightarrow -4 \rightarrow 4$$

$$\Delta e \rightarrow -1 \rightarrow 1$$

$$u \rightarrow -9 \rightarrow 9$$

Find  $u_{crisp}$

①  $e=3$  and  $\Delta e=-0.5$

②  $e=-2$  and  $\Delta e=-0.2$

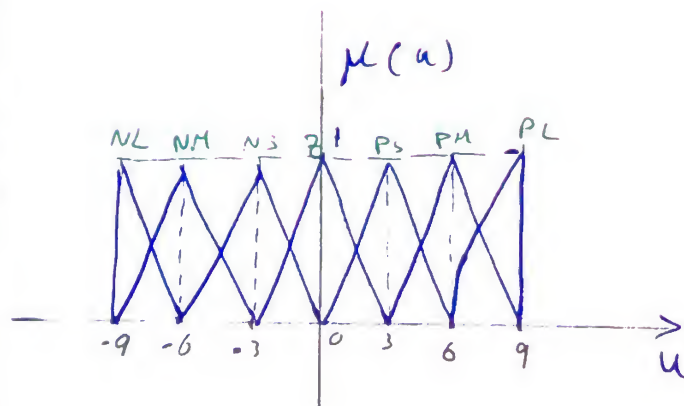
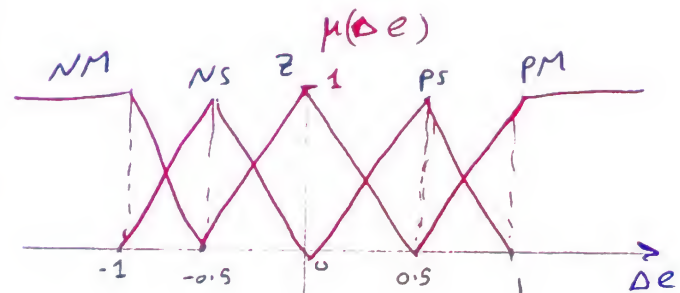
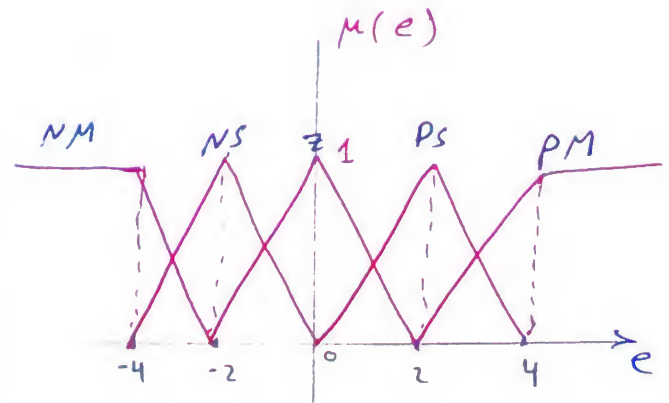
③  $e=2.6$  and  $\Delta e=0.35$

$e \backslash \Delta e$	NM	NS	Z	PS	PM
PM	PL	PL	PM	PS	Z
NS	PL	PM	PS	Z	NS
Z	PM	PS	Z	NS	NM
PS	PS	Z	NS	NM	NL
PM	Z	NS	NM	NL	NL

① Fuzzification

$$e=3 \rightarrow \begin{cases} PS \rightarrow \mu=0.5 (PS) \\ PM \rightarrow \mu=0.5 (PM) \end{cases}$$

$$\Delta e=0.5 \rightarrow NS \rightarrow \mu=1 (NS)$$



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## [2] Fired rules

R1: if  $e$  is  $ps$  and  $oe$  is  $ns$  then  $u$  is  $z$

R2: if  $e$  is  $PM$  and  $oe$  is  $ns$  then  $u$  is  $NS$

## [3] the grade or degree of premise part.

$$R1 \rightarrow \mu_{P_1} = \min \left\{ \mu_{ps}(e) ; \mu_{ns}(oe) \right\} = \min(0.5, 1) = 0.5$$

$$R2 \rightarrow \mu_{P_2} = \min \left\{ \mu_{PM}(e) ; \mu_{ns}(oe) \right\} = \min\{0.5, 1\} = 0.5$$

## [4] the fuzzy forms of the outputs

$$R1 \Rightarrow \mu_z(u) = \min \left\{ \mu_{P_1}, \mu_z(u) \right\} = \min\{0.5, \mu_z(u)\}$$

$$R2 \Rightarrow \mu_{NS}(u) = \min \left\{ \mu_{P_2}, \mu_{NS}(u) \right\} = 0.5$$

## [5] ~~Defuzzification~~ Do fuzzification

$$u^{crisp} = -1.5$$

for input in [2] and [3]

you will do the same as in [1]

